Variations of dioxin in the gas cooling process of MSW incinerator

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1. Introduction

Recently, the value of the Japanese Health and Welfare Ministry's guideline on dioxin emission from new continuous type incinerator[1] was lowered to 0.1 ng-TEQ/Nm^3. In order to control the dioxin emission below this value, it has been said that the advanced flue gas treatments such as adsorption by activated carbon or catalytic decomposition are necessary[1,2].

However, we found that the dioxin emission could be reduced to below 0.1 ng-TEQ/Nm^3 without advanced treatments through the investigation of new stoker type incinerators as shown in Figure 1. In this paper we report some results on the dioxins measured in the gas cooling process of new stoker type incinerators.

2. Analytical method

Figure 2 is the flow sheet of a new stoker type incinerator, in which the sampling points of dioxins and their temperature are shown.

Two kinds of dioxin samples were taken; one sampled before the flue gas reached the filter paper at the dust collector part, and the other collected at the downstream of the dust collector part. The former is called the particulate dioxins and the latter is called the gaseous dioxins. They were analyzed separately. The contents of pentachlorobenzene (P5CBz) and hexachlorobenzene (H6CBz) in the samples were also analyzed. Dust was extracted at the economizer outlet and measurements were made on the surface area, pore volume, and pore diameter of the dust.

3. Results and discussions

Figures 3 and 4 show variations of dioxins in the new incinerator collected from the five sampling points. Although the concentration of polychlorinated dibenzodioxins (PCDDs) was low at the furnace outlet, it increased significantly during the gas cooling process reaching the ten-fold value at the bag filter inlet. In contrast, the concentration of polychlorinated dibenzofurans (PCDFs) was highest at the furnace outlet; it was reduced by 30% in the boiler, and changed little in the following stages. The concentration of gaseous dioxins, constituting 1 - 2% of overall dioxins at the furnace outlet, increased by 30 - 70% in the boiler and decreased in the gas cooling process.

Most particulate dioxin that increased in the gas cooling process was easily removed in the bag filter, while from 65 - 90% of gaseous dioxin was removed in the same filter. As an overall rate, the bag filter achieved 99% dioxin removal.

Figures 5 and 6 show variations in dioxin congeners. In case of particulate PCDDs, each congener increased equally in the cooling process. In particulate PCDFs, high-chlorinated congeners decreased in the boiler, and increased no more in the downstream.

In contrast, the concentration of low-chlorinated compounds, in both gaseous PCDDs and gaseous PCDFs, increased in the boiler, while that of high-chlorinated compounds decreased. In the cooling process that followed, there was a decreasing tendency in the concentrations of PCDDs and PCDFs with higher chlorination.

Figures 7 and 8 show variations in pentachlorobenzene (P5CBz) and hexachlorobenzene (H6CBz), respectively. Although the both concentrations increased by 2.5 - 3 times in the boiler, they changed little in the following stages. Unlike dioxins, the most part of these compounds was gaseous. However, about 90% of such gaseous P5CBz and H6CBz were removed in the bag filter.

Table 1 shows some analytical results of the dust sampled at the economizer outlet. The characteristics of the flyash, such as specific surface area and pore volume, are similar to those of the adsorbent that was used to remove dioxins in the study reported by Katsuura et al[3]. This may explain why the removal rate of dioxins in the bag filter was high.

However, it is not clear why the fabric filter settled inside the bag filter could remove the gaseous compounds, which passed through the glass fiber filter in the sampling device.

4.References

1) Japanese Health and Welfare Ministry, New Guidelines for Controlling Dioxins and Dibenzofurans in Municipal Waste Treatment, (1997)

2) Uwe Lahl, Barbara Zeschmar-Lahl, and Dieter O. Reimann : PCDD/F-Emission of MSWI : A status report on emission reduction means in Germany, Organohalogen Compounds Vol. 23, 413-417 (1995)

3) Katsuura H, Inoue S, Tanaka S: Simultaneous reduction of dioxin and mercury in the flue gas used by the adsorbent, Proceedings of the 7th Annual Conference of Japan Society of Waste Management Experts, 536 – 538, 1996

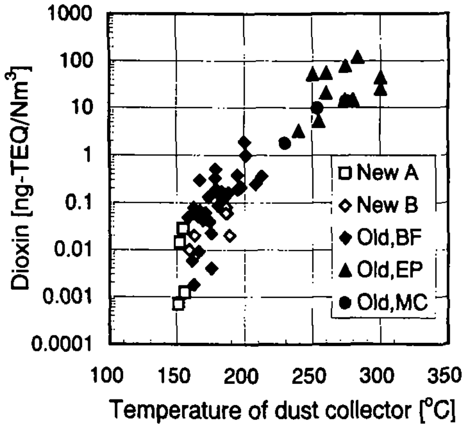


Figure 1 The relationship between the temperature and dioxin

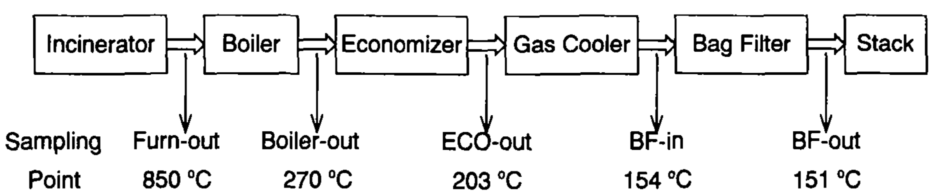
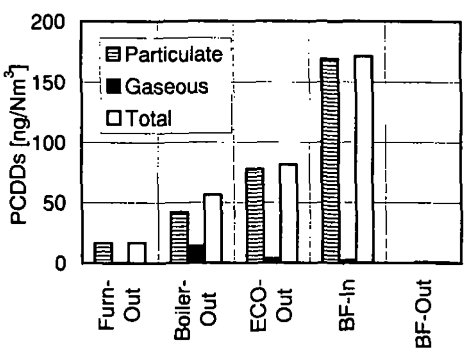
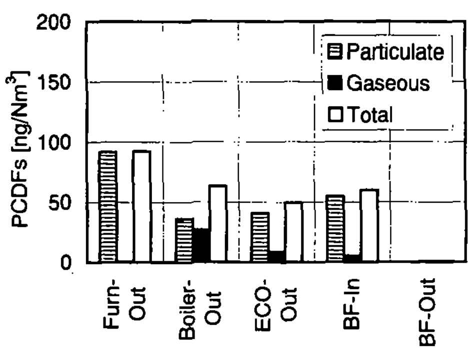


Figure 2 Flow sheet of new stoker type incinerator and sampling points of dioxin



Fifure 3 Variations of the PCDDs between furnace outlet and bag filter outlet



Fifure 4 Variations og the PCDFs between furnace outlet and bag filter outlet

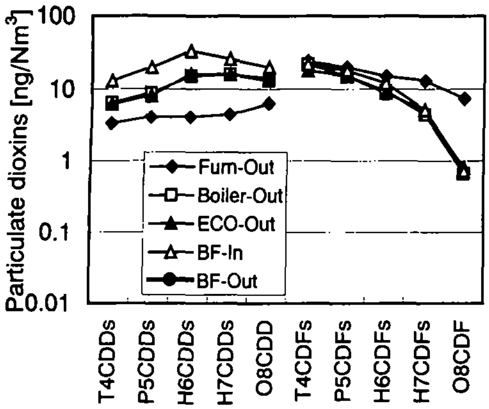


Figure 5 Variations of particulate dioxin congeners

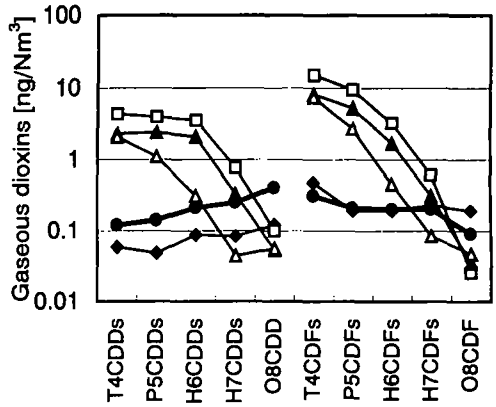


Figure 6 Variations of gaseous dioxin congeners

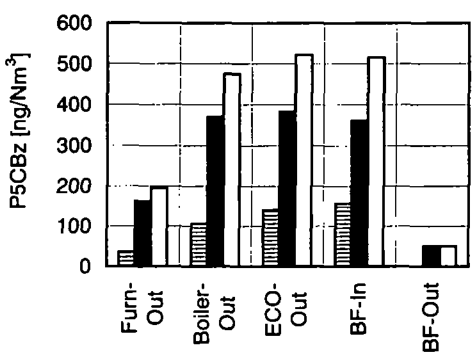


Figure 7 Variations of pentachlorobenzene

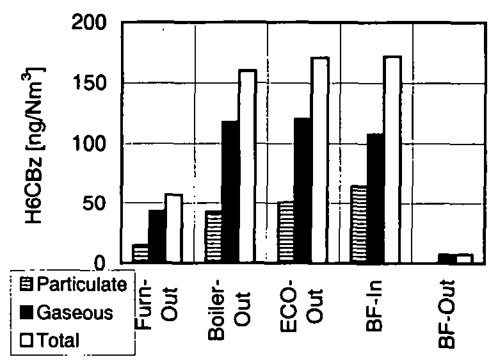


Figure 8 Variations of hexachlorobenzene

Table 1 Analysis results of dust sampled at the economizer outlet

Dust concentration [g/Nm³]	2.1
Langmuir surface area [m²/g]	20.1
BJH cumulative adsorption pore volume of pores [cc/g]	0.02
Micropore volume (< 1 nm) [cc/g]	0.002
Average pore diameter [nm]	33.5